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# CLAIMS

1. A direct oxidation fuel cell system, comprising:

(A) a fuel source;

(B) a direct oxidation fuel cell, having:

(i) a membrane electrode assembly, including;

(a) a protonically conductive, electronically non-conductive membrane electrolyte, having an anode face and an opposing cathode face; and

(b) a catalyst coating disposed on each of said anode face and said cathode face, whereby electricity-generating reactions occur upon introduction of an associated fuel solution from said fuel source including anodic dissociation of said fuel solution into carbon dioxide, protons and electrons, and a cathodic combination of protons, electrons and oxygen from an associated source of oxygen, producing water; and

(ii) an anodic diffusion layer disposed in intimate contact with said anode face of said membrane electrode assembly and having a plurality of openings therein to allow said associated fuel solution to pass through to said anode face, as fuel is consumed at said anode;

(iii) a cathodic diffusion layer disposed in intimate contact with said cathode face of said membrane electrode assembly and having a plurality of openings therein to allow oxygen to pass through to said cathode face of said membrane electrode assembly;

(C) a gas permeable layer comprised substantially of a gas permeable material, said gas permeable layer being disposed generally parallel to said anodic diffusion layer, such that said fuel solution can pass between said anodic diffusion layer and said gas permeable layer, and carbon dioxide that is released as fuel is consumed at said anode face, passes through said gas permeable layer and is vented from said fuel cell, whereby carbon dioxide is removed from said fuel cell without active transport mechanisms; and

(D) gas permeable layera load coupled across said fuel cell, said load providing a path for said electrons whereby electricity is provided as said electricity-generating reactions proceed.

2. The direct oxidation fuel cell system as defined in claim 1 further comprising a pressurized fuel delivery assembly coupled between said fuel source and said anodic diffusion layer in such a manner that as fuel is consumed at said anode face, and carbon dioxide is separated by said gas permeable layer, fuel is drawn into said fuel cell and said fuel cell is refilled by volume replacement from said fuel delivery assembly.

3. The direct oxidation fuel cell system as defined in claim 1 further comprising means for evaporating off water produced at said cathode face of said protonically conductive membrane.

4. The direct oxidation fuel cell system as defined in claim 1 wherein said gas permeable layer is comprised substantially of expanded PTFE.

5. The direct oxidation fuel cell system as defined in claim 1 wherein said gas permeable layer further includes a flow field channel formed therein to assist in the transport of liquids to said anode face of said protonically conductive membrane, while gases are drawn through said gas permeable layer.

6. The direct oxidation fuel cell system as defined in claim 4 wherein said flow field channel is sealed with a material that is liquid impermeable, gas permeable, to resist passing of fuel through said gas permeable layer, by allowing gas to pass through to said membrane.

7. The direct oxidation fuel cell system as defined in claim 1 further comprising a housing encapsulating said direct oxidation fuel cell, said housing having an inlet port for the introduction of fuel into said fuel cell.

8. The direct oxidation fuel cell system as defined in claim 6 further comprising a second port being defined in said housing into which fuel can be introduced, or removed, from the fuel cell.

9. The direct oxidation fuel cell system as defined in claim 1 wherein said protonically conductive membrane is comprised substantially of Nafion.

10. The direct oxidation fuel cell system as defined in claim 1 wherein said fuel from said fuel source is a methanol solution.

11. The direct oxidation fuel cell system as defined in claim 1 wherein said anodic diffusion layer is sandwiched between said gas permeable layer and said protonically-conductive membrane.

12. The direct oxidation fuel cell system as defined in claim 1 wherein said gas separation membrane is in intimate contact with said anodic diffusion layer.

13. The direct oxidation fuel cell system as defined in claim 7 wherein said gas permeable layer is disposed on a portion of said housing, encompassing said anode chamber.

14. The direct oxidation fuel cell system as defined in claim 11 wherein said gas permeable layer is disposed on at least one surface of said housing.

15. The direct oxidation fuel cell system as defined in claim 11 wherein said gas permeable layer comprises at least one porthole in said housing.

16. A direct oxidation fuel cell, comprising:

(A) a membrane electrode assembly, including:

(i) a protonically conductive, electronically non-conductive membrane electrolyte, having an anode face and an opposing cathode face; and

(ii) a catalyst coating disposed on each of said anode face and said cathode face, whereby electricity-generating reactions occur upon introduction of fuel solution from an associated fuel source, including anodic dissociation of said fuel solution into carbon dioxide, protons and electrons, and cathodic combination of protons, electrons and oxygen from an associated source of oxygen, producing water;

(B) an anodic diffusion layer disposed in intimate contact with said anode face of said membrane electrode assembly, and having a plurality of openings therein to allow said associated fuel mixture to pass through to said anode face as fuel is consumed at said anode;

(C) a cathodic diffusion layer disposed in intimate contact with said cathode face of said membrane electrode assembly and having a plurality of openings therein to allow oxygen to pass through to said cathode face of said membrane electrode assembly; and

(D) a gas permeable, fluid impermeable membrane disposed generally parallel to said anodic diffusion layer, such that said fuel solution can pass between said anodic diffusion layer and said gas permeable membrane to separate carbon dioxide that is released at said anode face and to vent carbon dioxide from said fuel cell, whereby carbon dioxide is removed from said fuel cell without active transport mechanisms.

17. The direct oxidation fuel cell as defined in claim 16 wherein said gas permeable membrane is comprised substantially of expanded PTFE.

18. The direct oxidation fuel cell as defined in claim 17 wherein said gas permeable membrane includes a flow field channel to assist in the transport of liquids across said anode face of said protonically conductive membrane, while gases are drawn through said gas permeable membrane.

19. The direct oxidation fuel cell as defined in claim 18 wherein said flow field channel is sealed with a material that is liquid impermeable to resist passing of fuel through said gas permeable layer.

20. A fuel container and delivery assembly for use with an associated direct oxidation fuel cell system, the fuel container and delivery assembly, comprising:

(A) an exterior housing having an opening at one end thereof;

(B) a first inner container disposed within said exterior housing, for holding a fuel solution, and a fuel conduit extending through said opening in said exterior housing, and coupling said first inner container to said associated fuel cell system;

(C) a second inner container disposed within said exterior housing, for holding water to be mixed with said fuel solution and a water conduit extending through said opening in said exterior housing, and coupling said second inner container to said associated fuel cell system;

(D) an interface for sealing the coupling of said fuel conduit and said water conduit with said associated fuel cell system;

(E) mixing assembly connecting said fuel conduit with said water conduit to mix fuel and water to adjust an amount of water mixed into fuel to result in a fuel mixture of a predetermined concentration; and

(F) delivery conduit for transporting said resulting fuel mixture to said associated direct oxidation fuel cell system.

21. The fuel container and delivery assembly as defined in claim 20 wherein said fuel conduit is constructed to intersect into said water conduit to thereby mix said fuel solution with water.

22. The fuel container and delivery assembly as defined in claim 21 further comprising a valve located along said fuel conduit to control the addition of fuel solution to be mixed with said water.

23. The fuel container and delivery assembly as defined in claim 20 wherein said water conduit is constructed to intersect into said fuel conduit to thereby mix water into said fuel solution.

24. The fuel container and delivery assembly as defined in claim 23 further comprising a valve located along said water conduit to control the addition of water to be mixed into said fuel solution.

25. The fuel container and delivery assembly as defined in claim 20 further comprising a mixing chamber into which said fuel conduit and said water conduit lead to thereby mix said fuel solution and said water.

26. The fuel container and delivery assembly as defined in claim 25 further comprising a valve located along at least one of said fuel conduit and said water conduit to control the flow of liquids into said mixing chamber.

27. The fuel container and delivery assembly as defined in claim 26 further comprising a valve located along said delivery conduit to control the flow of the resulting fuel mixture to said associated direct oxidation fuel cell system.

28. The fuel container and delivery assembly as defined in claim 27, wherein said fuel conduit and said water conduit include openings along walls thereof, and said walls of said fuel conduit and said water conduit are disposed contiguous to said anode diffusion layer, which in turn is in intimate contact with said anode face of said fuel cell, whereby

fuel and water are dispersed through said walls of said conduits to said anode diffusion layer.

29. The fuel container and delivery assembly as defined in claim 28 wherein said fuel conduit and said water conduit include means for controlling the amount of each substance that travels through its respective conduit to thereby control the fuel concentration of liquids presented to said anode face of said fuel cell.

30. The fuel container and delivery assembly as defined in claim 20 wherein said associated fuel cell includes a gas permeable layer disposed generally parallel to said anodic diffusion layer, said gas permeable layer removing carbon dioxide from said fuel cell.

31. The fuel container and delivery assembly as defined in claim 30 wherein said gas permeable layer is comprised substantially of expanded PTFE.

32. The fuel container and delivery assembly as defined in claim 30 wherein said fuel cell includes means for evaporating off water produced at said cathode face of said membrane electrode assembly.

33. The fuel container and delivery assembly as defined in claim 20 wherein said exterior housing includes a pressure-applying element which applies pressure to at least one of said fuel container and said water container to place liquids in said fuel conduit and said water conduit under pressure.

34. The fuel container and delivery assembly as defined in claim 20 further comprising a pump to transport liquid fuel from said fuel container into said fuel conduit.

35. The fuel container and delivery assembly as defined in claim 20 further comprising a pump to transport water from said water container into said water conduit.

36. A method of removing carbon dioxide from a direct oxidation fuel cell, said fuel cell having a protonically conductive membrane, said protonically conductive membrane having an anode, and an anode diffusion layer, and a cathode, the method including the steps of:

separating carbon dioxide from said anode by providing a gas permeable layer, comprised substantially of a gas permeable, liquid impermeable material contiguous to an anodic diffusion layer, which is in turn, in intimate contact with said protonically conductive membrane allowing removal of carbon dioxide generated at said anode, and while allowing fuel solution to penetrate to said anode.